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# A framework to analyse the implications of coastal transformation on inclusive development

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ABSTRACT

People have been adapting to climate variability and change, with varying degrees of success, for millennia. Yet many individuals and communities struggle to adapt to present day climate variability and extremes. If, as climate projections suggest, we are heading towards a possible 4 °C increase in temperature by 2100, the adaptation deficit could increase significantly. 'Transformation' that is radical, rapid and revolutionary and that fundamentally changes the nature of a system may be a better way of adapting, by moving away from limiting behaviours and creating new opportunities. Here we explore the possible impact of alternative types of transformation on development. We focus on transformations in the coastal zone, as globally, this is an area of high population growth, as well as exposed to many natural hazards. We consider three main types of coastal transformation that reflect the main approaches to coastal management: protect, accommodate and retreat. To explore the possible impact of alternative transformations on coastal communities we develop and apply an analytical framework based on ideas of inclusive development (defined as *Access* to resources; *Allocation* of both resources and the impacts associated with climate change; and, individual *Subjective Wellbeing*). We apply this AASW framework to different types of coastal transformation to understand what it might add to our understanding of transformation. We conclude that the AASW framework is useful in identifying that past coastal transformations have not generated universal benefits, and have created some losers. Specifically, it highlights that coastal transformations have different effects on different people; and that winners and losers are determined by whose agenda is taken into account in planning the transformation. This insight reinforces the need for further research on the impacts of coastal transformation, as without due care, policies designed to generate transformation can generate significant losers.

## 1. Introduction

The United Nations seventeen Sustainable Development Goals (SDGs) are designed to increase human wellbeing and environmental sustainability, as well as minimising the gap between rich and poor - which are the basic principles of inclusive development (Gupta et al., 2015; Gupta and Vegelin, 2016). Achieving these goals is complicated by the rapid pace of social and climatic change in Least Developed Countries (LDCs) (International Institute for Environment and Development (IIED, 2015).

Unless there is a substantial 'over-delivery' of the actions promised in the Paris Agreement (2015), it is entirely possible that temperature increases of 4 °C will occur by 2100 (Rogelj et al., 2016). This could have potentially devastating effects in coastal areas leading to a sea-level rise of 2 m by 2100 (Nicholls et al., 1934). Thus, there is a slow acceptance that we will have to adapt to a world that is dramatically different if we are to avoid human catastrophe (O'Brien, 2012) and achieve the SDGs (Smit and Pilifosova, 2003; Griggs et al., 2013).

Reflecting the idea that current adaptations are not adequate for the changes we face, adaptation debates increasingly focus on the need for transformational change that is radical, rapid and revolutionary and fundamentally changes the nature of a system (O'Brien, 2012; Folke et al., 2010; Kates et al., 2012; Rickards and Howden, 2012; Pelling et al., 2015; O'Brien, 2016; Few et al., 2017). However, there is no clear framework to analyse the potential impacts of transformational change (henceforth used synonymously with transformation) on human development.

Despite efforts to document case studies of current adaptation (e.g. Tompkins et al., 2010; Ford et al., 2011; Tompkins et al., 2017) we still know relatively little about the spectrum and prevalence of adaptation

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in practice (Tompkins et al., 2018), including which initiatives may turn out to have damaging impacts – however these are measured (Barnett and O'Neill, 2010; Magnan et al., 2016). It is possible that the profound changes associated with transformation could create more damage than current adaptation interventions (Matyas and Pelling, 2015). Thus, radical paradigm shifts leading to transformation should take into account the potential for negative impacts, including inequitable outcomes for different groups in a society, to minimise the impact of unintended consequences for inclusive development (Lonsdale et al., 2015). The aim of this paper is to apply an innovative framework to explore the possible impact of transformation on development, thereby providing policy-makers with evidence to inform transformation decisions that are in-line with their priorities, and ensuring that we 'leave no one behind'.

## 2. Transforming coasts

### 2.1. Defining transformational change

The IPCC AR5 recognises that transformation is different from incremental adaptation (Noble et al., 2014). Incremental adaptations are interventions that occur in small steps and that do not drastically change existing political, social or household structures and norms (Park et al., 2012; Wise et al., 2014; Eriksen et al., 2015). From a human development perspective, these adaptations operate within the current system to reduce socio-economic vulnerability; address disaster risk; and/or build social-ecological resilience (Tompkins et al., 2018; McGray et al., 2007; Eakin et al., 2009). However, there is recognition that slow-paced adaptation to climatic stresses, shocks and variability may not be enough to enable the most vulnerable communities to achieve and maintain prosperity in a changing climate (Kates et al., 2012; Pelling et al., 2015; Roggema et al., 2012).

We review the notion of transformational change, as an activity that seeks to challenge the current system by instigating ambitious change across larger scales, in new geographic regions or resource systems, and by transforming places (Kates et al., 2012). A change may be transformational at its conception, and then become part of a suite of incremental adaptation options. For example, the Thames Estuary barrier that protects London from flooding, and the engineered delta protection system in the Netherlands were both transformational in concept, but have been operationalised through traditional activities, such as community participation and introduction of coastal barriers (Kates et al., 2012; Ranger et al., 2013). This paper focusses on the aim of transformation. This focus can help us understand what counts as transformative, and enable us to document and analyse more carefully the nature and impacts of transformation on development. Thus, we draw on work from the natural and social sciences to define transformation as that which seeks to address the root causes of vulnerability and exposure to hazards by introducing interventions from outside the current practice in a given location (Few et al., 2017; Tschakert and Clair, 2013; Blaikie et al., 2014). Transformation itself is therefore the adaptation.

### 2.2. Is transformation needed in coastal areas?

Coasts are particularly vulnerable to the impacts of climate change (Nicholls et al., 2007; Wong et al., 2014). For example, sea-level rise (SLR), intense storms and changes in wave action under predicted climate futures are likely to lead to submergence of land, flood damage, coastal erosion and increasingly saline land (Church et al., 2013; Christensen et al., 2013). These impacts are compounded by rising migration to the coast and the consequent increase in population numbers and density, and in LDCs by poverty and low levels of human development (McGranahan et al., 2007).

Coastal communities have adapted to social and climatic changes for millenia, however, research on incremental coastal adaptation suggests that current approaches may not be sufficient to deal with the magnitude of changes currently happening, and expected in the future. For example, research from the east coast of Australia has shown that current adaptation plans, including a boulder seawall, beach nourishment and offshore submerged reefs, would only withstand a SLR of 1 m (Cooper and Lemckert, 2012). A rise of 5 m or more could lead to the abandonment of the city of Brisbane. Transformation, i.e. a systemic change in approach, may thus be needed in coastal areas to expand the range of adaptation opportunities (Hino et al., 2017; Brown et al., 2017). However, until we are able to evaluate the impacts of transformation we cannot assert that it will improve upon existing incremental adaptation. A framework is needed to evaluate the impacts of transformation on development.

## 3. Alternative types of transformation: protection, accommodation and retreat

To understand types of coastal transformation, we group them into the three broad categories of coastal management: protection, accommodation and retreat. These three categories have been part of coastal adaptation discourses since the early 1990s (Gilbert and Vellinga, 2010) and are now widely used to organise and analyse adaptation strategies to deal with coastal change (Nicholls et al., 2007; Suckall et al., 2018). While not commonly used in discussions about transformation or human development, we apply the protect-accommodate-retreat typology to describe a set of transformational choices available to coastal communities.

### 3.1. Protect

Protecting coasts is about minimising further damage to people, property or infrastructure (Nicholls et al., 2007). These may be through hard measures (such sea walls, dykes and groynes) or soft measures (such as beach nourishment and mangroves). Perhaps the best known protective transformation is the Netherlands delta works, a 50 year project starting in 1957 and ending in 2010 with the building of the Maeslantkering storm surge barrier. The delta works project moved away from a traditional system of building levees, and instead 'made room for water' by creating canals and protecting the surrounding area by dams and dikes (Van der Brugge et al., 2005). Although the project took place over a relatively long time scale, it can be classed as transformational because of the scale, intensity, novelty and new combinations of adaptations (Kates et al., 2012). On the Mekong Delta, Vietnam, high dykes were built after a severe flood in 2000 (Chapman and Darby, 2016; Chapman et al., 2016; Triet et al., 2017). The high dyke system uses hard infrastructure to displace flood water to improve agricultural productivity in a highly exposed deltaic environment, specifically, to enable a third annual rice crop to be grown. Protection is most visible in areas of high economic worth and high population density.

### 3.2. Accommodate

Accommodating change allows damage, such as erosion, to take place; however, the severity of impacts are mitigated by adapting physical and social structures to allow systems to cope with the change (Nicholls et al., 2007). In Bangladesh, early warning systems (EWS) and cyclone shelters have allowed communities to live with severe storms (Lumbroso et al., 2017). The EWS relies on volunteers who rapidly spread government warnings throughout their community; community members then take refuge in cyclone shelters until the winds and flooding pass. This system has radically reduced cyclone fatalities, for example, Cyclone Gorky in 1991 (i.e. pre-EWS) led to around 140,000 deaths; Cyclone Sidr, a similar sized storm in 2007 (i.e. post-EWS), resulted in 3406 fatalities (Paul, 2009). Another example from Bangladesh is the adoption of the 'build back better' approach, which incorporates disaster risk reduction into post-disaster recovery and rehabilitation (UNISDR, 2015). Following Cyclone Aila in 2009, the

United Nations Development Programme funded a 'build back better' reconstruction project in flood prone Satkhira district. A new village of 50 homes raised 2 m above the ground was designed to withstand 150mph winds and storm surges of 2 m (Charlesworth and Ahmed, 2015). A final example of accommodative transformations are land zoning schemes, such as coastal buffer zones designed to help communities live with coastal flooding (Kennedy et al., 2008). For example, following the non-climate related 2004 Indian Ocean tsunami, the government of Sri Lanka transformed its policy making processes and imposed a "no reconstruction" zone of up to 0.2 km to prevent a similar disaster (Ingram et al., 2006).

### 3.3. Retreat

Retreating involves allowing damage such as erosion and flooding to take place. Instead of fighting against nature, land use is changed (Nicholls et al., 2007). Retreat can involve the managed abandonment and relocation of communities and the creation of coastal wetlands or other forms of intertidal habitats (Esteves, 2013). In the Philippines, the Municipal Government of Tubigon has established a relocation programme for island households at risk of SLR (Laurice Jamero et al., 2017). Similarly, in the Vietnam Mekong Delta the government launched the 'Living With the Flood' programme whereby 1000 resettlement clusters were built to house people who live in permanently flooded areas (Danh and Mushtaq, 2011). Government management relocation has also been used in Keta in the Volta delta, Ghana, where erosion continues to threaten coastal communities (Danquah et al., 2014). In a non-LDC context, debates around paying people to move away from flood danger have emerged in New Orleans where the Mississippi poses a serious threat to human life (Scientific American, 2015). Of the three transformations, retreat is the least researched and understood option.

## 4. The impact of coastal transformation on inclusive development

To understand the potential impact of transformation on inclusive development we conceptualise local-scale inclusive development in terms of three main components: access, allocation and subjective wellbeing (AASW). By interrogating alternative coastal transformations through the lens of these three components (access, allocation and subjective wellbeing), we propose that policy makers could be better placed to assess the merits of transformational policy choices, see Fig. 1.

The first two components within the AASW framework, access and allocation, explain distributional issues relating to 'access to basic resources' and the 'allocation, or distribution, of surplus resources' (Gupta and Lebel, 2010; Griggs et al., 2013). Following Gupta and Lebel (2010), we merge different perspectives on access and allocation to take into account physical access to resources as well as social processes affecting access and allocation, thereby accounting for the common elements of socio-economic development.

The concept of access is underpinned by the poverty and famine literature of the 1980s (e.g. Sen, 1981, 1999; Drèze and Sen, 1991). Prior to Sen's work, the cause of famine was believed to be related to a combination of inadequate food production techniques, lack of infrastructure and natural hazards. Sen argued that famine does not occur solely because of lack of food availability, but also because of individual entitlements and endowments. Rising food prices, falling wages, falling cash crop prices, as well as legal, political, economic and social characteristics of the society all affect these entitlements, and hence access to food (Rubin, 2009). Following Gupta and Lebel (2010) we apply this understanding of the drivers of access to all basic resources, including access to: land, food, water, housing and services such as energy.

Allocation is commonly used to describe the distribution of resources between people but can also refer to the distribution of impacts, e.g. over time and space, of a change or action (Gupta and Lebel, 2010). Allocation considers both distribution and equitability of impacts.

The third component, subjective wellbeing, is an important aspect of inclusive development where social welfare is recognised as an equally important goal alongside economic growth (Gupta et al., 2015; Pouw and McGregor, 2014). We draw on a body of literature that suggests indicators of subjective wellbeing such as happiness or life satisfaction are linked with access to, and use of the natural environment (Costanza et al., 1997; MacKerron and Mourato, 2013; Agarwala et al., 2014). Hence, we argue that subjective measures of subjective wellbeing act as useful indicators or important components of transformational change, in addition to purely socio-economic elements.

Using these three components of human development, we now discuss the impacts of coastal transformation, and the implications for policy making. Examples are used to illustrate how this framework highlights the gains and losses associated with transformation that previously have remained invisible.

### 4.1. Access

To understand the impact of transformation on access to resources, we examine two questions: (1) are basic resources available? and, (2) are basic resources physically accessible?

#### 4.1.1. Are basic resources available?

Availability of resources is likely to change under coastal transformations. For example, following seawall construction in Kerala, India, there was a perception amongst the fishing community that habitat characteristics of their fishing grounds had changed, reducing numbers of some fish species (Santha, 2015), i.e. basic resources were becoming scarce. Similarly, there is potential for transformation to reduce land availability. For instance, during the concept stage of the new multi-

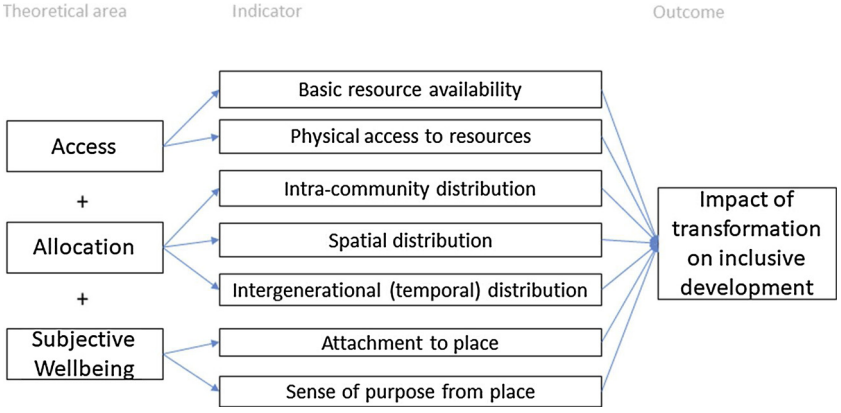


**Fig. 1.** Proposed Access, Allocation, and Subjective Wellbeing (AASW) framework to evaluate the impact of transformation on development.

purpose disaster shelter programme in Bangladesh it was recognised that involuntary land acquisition may be required to build the shelters (World Bank, 2014). With careful planning, opportunity exists to increase access to basic resources with coastal transformation. For example, resources such as homes, water and electricity have been made available to relocated communities in Keta, Ghana, that previously lived in unsuitable conditions (Laurice Jamero et al., 2017; Danquah et al., 2014). Thus, we suggest that the availability of resources may decline under protect, accommodate or retreat interventions unless there is pro-active approach toward increasing their availability. Securing resource availability may lead to increased development.

#### 4.1.2. Are basic resources accessible?

In terms of the physical accessibility of resources, different forms of transformation have different impacts. For example, in Kerala, India, the creation of protective infrastructure (a seawall) meant the fishing community were no longer able to access the beach where they had once fished with seine nets, nor were they able to use traditional beach trading posts; both of these factors threatened livelihoods (Santha, 2015). Interventions based around accommodating change, such as buffer zones, reduce the impacts of flooding but may compromise the livelihoods of poorer households. Following the Indian Ocean tsunami, the Indian government aimed to enforce a coastal regulation zone in Tamil Nadu. This would have led to the loss of coastal access and customary tenure rights of poorer coastal dwellers (ActionAid, 2006). The coastal buffer zone in Sri Lanka led also to increased vulnerability for some of the poorest households who were given no assistance with relocation (Ingram et al., 2006). It appears that planning that takes into account local access needs, may offer compromise. In the Netherlands, original plans for the Eastern Scheldt dam (built in 1986) would have stopped sea water entering the estuary thus preventing fishing communities from accessing aquatic resources. However, a participatory planning process meant that a semi-permeable dam was built, providing protection for the wider community whilst allowing fishing access (Meijerink, 2005).

### 4.2. Allocation of impacts of transformation

To understand the impact of transformation on allocation, i.e. distribution between people, we argue that three questions are important that reflect the spatial and temporal distribution of impacts: (1) is everyone in a community affected by an adaptation in the same way (intra-community equality); (2) does the intervention affect people outside the community (spatial equality); (3) are future generations affected (intergenerational equality)?

#### 4.2.1. Intra-community allocation?

Community members are rarely affected by an intervention in the same way, because they start off with different rights and resources reflecting factors such as gender, ethnicity and caste (Pearse, 2017). For example, in Vietnam, the high dykes, designed to prevent flooding mean poorer farmers lose sediment from flood events, once relied on to fertilise land (Chapman et al., 2016). Without flood-driven sediment, poorer farmers have increased spending on chemical fertilisers and labour due to reduced soil fertility (Käkönen, 2008). Further, as fields no longer flood, the landless are unable to catch wild fish during flood season (Howie, 2005). In comparison, wealthier farmers who are able to afford the additional fertiliser and labour inputs are able to realise increased profitability (Chapman and Darby, 2016).

#### 4.2.2. Spatial allocation?

We recognise that some households will be more affected by transformations than others due to the physical location of homes or sources of livelihood. In the Netherlands, 75 households in the De Noordwaard community lost their homes to make way for a floodplain that protected larger downstream settlements. Households were financially compensated or provided with elevated homes. In this case, opposition was overcome by creating incentives for the homeowners (Hino et al., 2017).

#### 4.2.3. Intergenerational allocation?

Due to the size and scale of transformations, both current and future generations could be affected. For example, transformational protective infrastructure such as coastal defences have a finite lifespan. To ensure longevity of the infrastructure maintainance is required and the economic and environmental cost will be borne by future generations (Cooper and McKenna, 2008). Interventions that promote retreat from the coast could deny future generations their cultural and environmental heritage unless they are designed in such a way as to protect cultural artefacts, or restore or recreate environments.

### 4.3. Subjective wellbeing

To understand the impact of transformation on subjective wellbeing we suggests a person's attachment to place, including the sense of purpose they derive from that place, creates feelings of wellbeing and security, even in highly stressed natural environments (Adger et al., 2013; Pollnac and Poggie, 2008). For example, evidence from the Philippines suggests that households prefer to stay in dangerous locations rather than relocate and risk losing fishing based livelihoods (Laurice Jamero et al., 2017). In Tuvalu, Pacific Islands, leaving a flood-prone environment is an absolute last resort for most islanders who want to retain a traditional, community-based lifestyle (Mortreux and Barnett, 2009).

Research from the Mississippi shows that accounting for place attachment in relocation plans, such as working with a community to move everyone as a whole, is more likely to lead to support for such schemes (Kick et al., 2011). In addition to relocation, in-situ transformations such as protective infrastructure (e.g. sea walls) can change the meaning of a place by preventing fishing. This may lead to a loss of job satisfaction and collective identity within a community (Pollnac and Poggie, 2008). Thus, non-income generating aspects of natural resources also need evaluation in transformations that fundamentally change the nature of a livelihood (Agarwala et al., 2014).

## 5. Conclusions/way forward

Transformation has the potential to reduce the most negative impacts of climate change. However, decisions are not without consequences. The proposed AASW framework highlights three important areas to be assessed when considering the potential implications of coastal transformations on the poorest and most vulnerable members of communities. It thereby provides policy-makers with evidence to inform decisions that are in-line with their priorities, and ensure we 'leave no one behind'.

Application of the framework in this paper has highlighted that decision-makers need to actively consider the trade-offs and socially- and spatially-differentiated consequences of transformational policy choices. Our findings suggest that this may be through ensuring financial compensation for losses, as in the Netherlands. Ensuring equitable benefits through compensation (in monetary form or otherwise) may be supported through adaptation finance arrangements. This could address some existing concerns regarding the extent to which existing transformations have effectively reduced vulnerability (Persson and Remling, 2014; Remling and Persson, 2015) and improve the likelihood of achieving the SDGs. Thus, by taking an approach that favours inclusive and equitable development, decision makers can reduce the risk of sleep walking into transformations that have a high social cost.

Transformations, when delivered with inclusive development in mind, may create opportunities to increase access to previously scarce resources. The example of participatory planning that takes into account local norms is highlighted by the case of the semi-permeable

Eastern Scheldt dam that allowed access to fishing livelihoods. In other cases transformation may improve access to water and electricity, e.g. for the relocated households in Keta, Ghana.

What are the future prospects for transformation as an adaptation? Our research has highlighted that unless a clear framework is applied to analyse the impacts of large-scale coastal transformations current and future generations may experience damaging side effects, marginalised losers, and long term losses of income and wellbeing. All coastal transformations, whether they actively alter the shape of the coast through physical intervention, or completely withdraw physical barriers, need to be evaluated for their impacts on inclusive development. Until we do this, we are at risk of creating transformations that are inconsistent with the SDGs, and may result in marginalised groups being 'left behind'.

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